Announcements

Homework for tomorrow...

Ch. 22, Probs. 30, 32, & 49

CQ2: a) & c)

22.10: 43.2°

22.12: 0.142 m

22.14: 396 nm

□ Office hours...

MW 10-11 am

TR 9-10 am

F 12-1 pm

□ Tutorial Learning Center (TLC) hours:

MTWR 8-6 pm

F 8-11 am, 2-5 pm

Su 1-5 pm

Chapter 22

Wave Optics
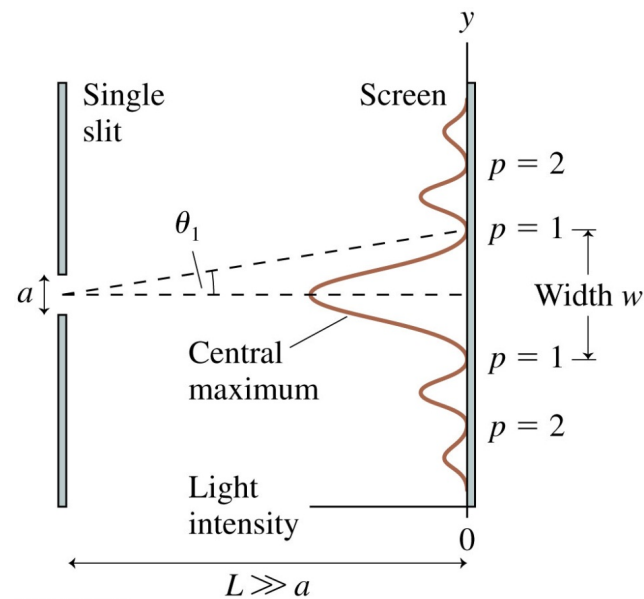*(Single-Slit Diffraction)*

Last time...

- The *intensity* of the bright fringes of the *diffraction grating...*

$$I_{max} = N^2 I_1$$

- The *dark fringes* of *single-slit diffraction* occur at *angular positions...*

$$\theta_p = p\frac{\lambda}{a} \quad , \quad p = 1, 2, 3, \ldots$$

Single slit

Screen

y

$p = 2$

$p = 1$

θ_1

a

Width w

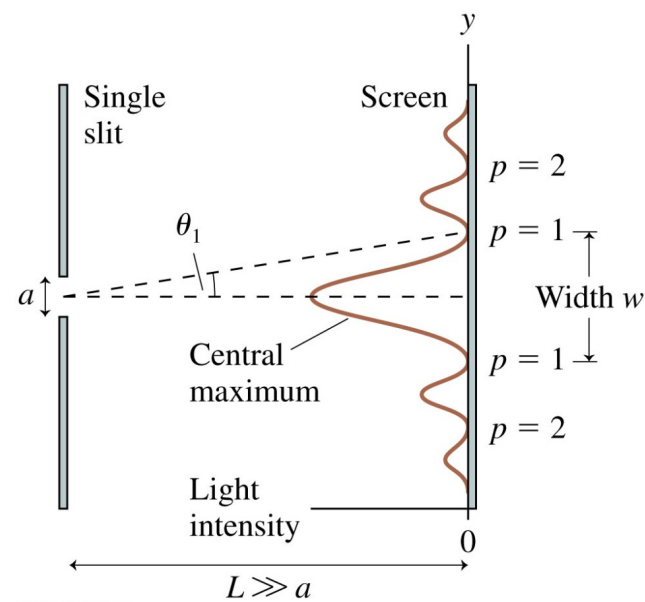Central maximum

$p = 1$

$p = 2$

Light intensity

0

$L \gg a$

i.e. 22.4:
Diffraction of a laser through a slit

Light from a helium-neon laser (λ = 633 nm) passes through a narrow slit and is seen on a screen 2.0 m behind the slit. The first minimum in the diffraction pattern is 1.2 cm from the central maximum.
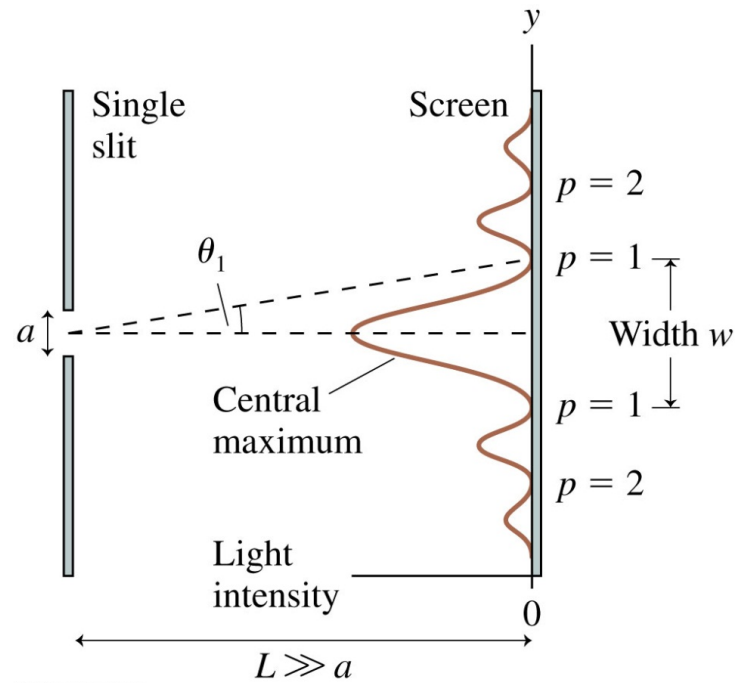
How wide is the slit?

The Width of a Single-Slit Diffraction Pattern...

The *angular positions* of the *dark fringes* in the interference pattern are..

$$\theta_p = p\frac{\lambda}{a} \quad , \quad p = 1, 2, 3, \ldots$$

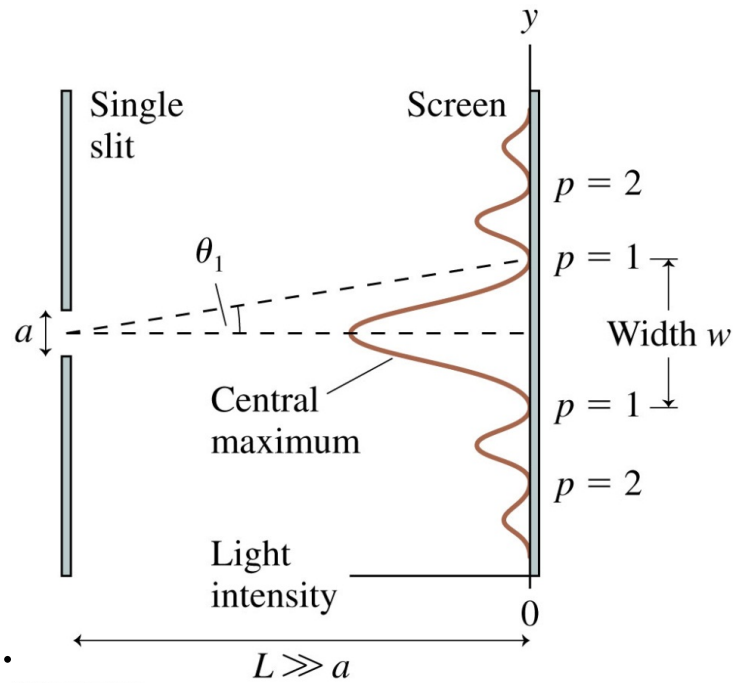Where does the pth dark fringe occur?

The Width of a Single-Slit Diffraction Pattern...

The *angular positions* of the *dark fringes* in the interference pattern are..

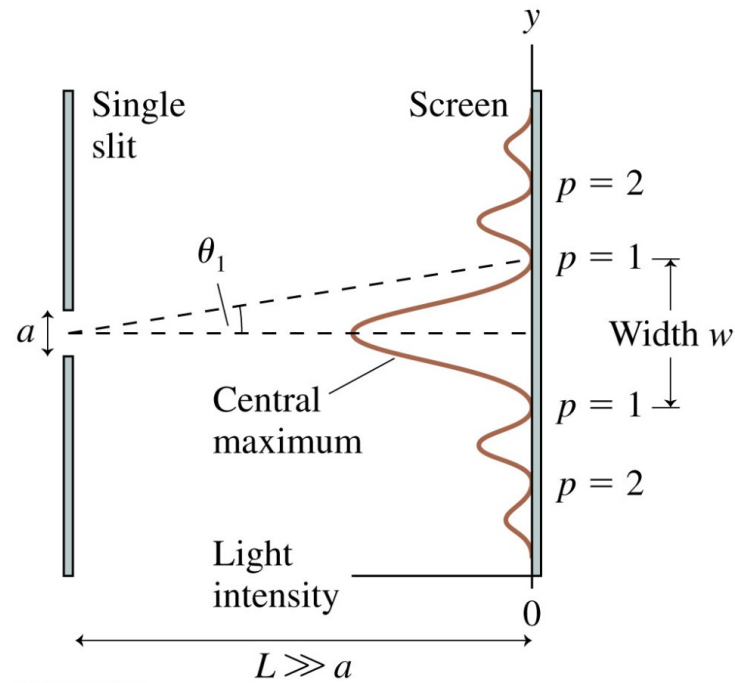$$\theta_p = p\frac{\lambda}{a} \quad , \quad p = 1, 2, 3, ...$$

Where does the pth dark fringe occur?

$$y_p = \frac{p\lambda L}{a} \quad , \quad p = 1, 2, 3, ...$$

Single slit

Screen

y

θ_1

a

$p = 2$

$p = 1$

Width w

Central maximum

$p = 1$

$p = 2$

Light intensity

0

$L \gg a$

The Width of a Single-Slit Diffraction Pattern...
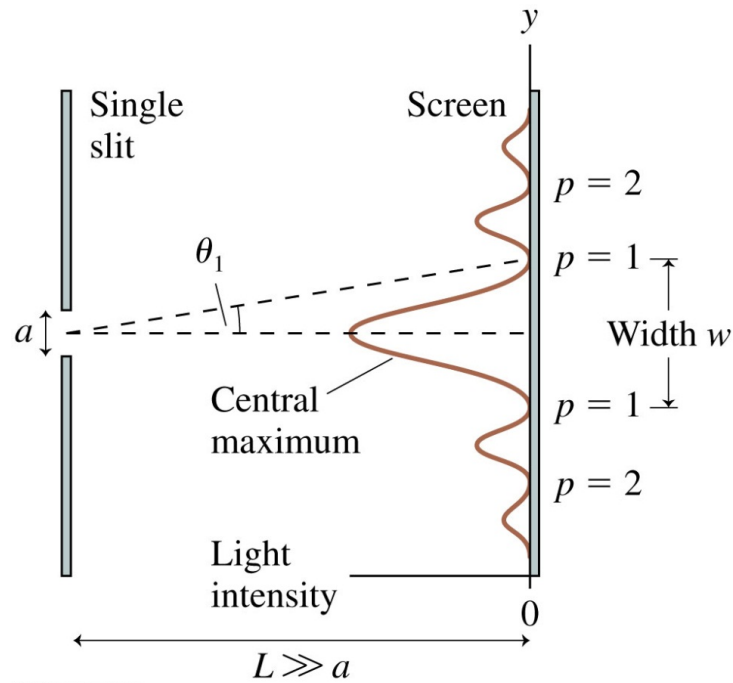
What is the *width* of the *central maximum?*

The Width of a Single-Slit Diffraction Pattern...

What is the *width* of the *central maximum*?

$$w = \frac{2\lambda L}{a}$$

Notice:

□ The *width* of the *central maximum* is *twice* the spacing between the dark fringes on either side.

□ The *smaller* the opening you squeeze a wave through, the *more* it spreads out on the other side.

i.e. 22.5:
Determining the wavelength

Light passes through a 0.12 mm wide slit and forms a diffraction pattern on a screen 1.00 m behind the slit. The width of the central maximum is 0.85 cm.

What is the wavelength of light?

Quiz Question 1

A laboratory experiment produces a single-slit diffraction pattern on a screen. The slit width is a and the light wavelength is λ. In this case,

1. $\lambda < a$.

2. $\lambda = a$.

3. $\lambda > a$.

4. Not enough info to compare λ to a.